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501
CONSUMABLE FLASH TUBE

BACKGROUND OF THE INVENTION

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5 The present invention relates to an igniter having a con-
6 sumable flash tube for encapsulating igniter material and more
7 particularly to an igniter having a flash tube for encapsulating
8 igniter material for the propellant beds in propelling charges or
9 rocket motors which functions as an environmental housing and
10 additionally functions as a grounded electrical conductor or
11 Faraday shield to bleed off any inadvertent electrical charge
12 presented to the flash tube.

13 Prior art flash tubes or ignition devices for igniting pro-
14 pellant beds commonly consisted of a high strength, seamless,
15 perforated steel tube for encapsulating the igniter material. The
16 use of a steel tube was required to provide pressure confinement
17 for the selected igniter material, black powder, and thereby
18 increase burning rate so as to obtain the pressure buildup required
19 for ignition. The steel tube is normally embedded in the propel-
20 lant bed to be ignited. The steel tubes are expensive in material
21 cost and require accurate and time consuming machining to tolerance.
22 In addition, the steel tubes require special quality assurance
23 inspection techniques to detect imperfections which could cause
24 tube rupture during ignition and result in improper performance
25 of the ignition assembly and propellant bed. These disadvantages
26 can be overcome by encapsulating a fast burning igniter material,
27 which does not require pressure confinement, in a consumable flash

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1 tube which is inexpensive and does not require elaborate and time
2 consuming machining or inspection techniques. A fast burning
3 igniter material does not require pressure confinement and thus
4 allows a consumable flash tube to be used in the igniter.

5 Prior art consumable flash tubes are best typified by the
6 devices disclosed in U.S. Patent Nos. 3,645,206, to Quinlan et al,
7 3,696,749, to Scanlon, and 3,828,676, to Junker. The device of
8 Quinlan et al discloses a consumable ignition system which ignites
9 a molded charge of single based propellant encompassing a project-
10 ile. Quinlan et al fails to disclose either a consumable flash
11 tube embedded in a propellant bed, per se, or a flash tube func-
12 tioning as an electrical conductor or Faraday shield.

13 The device of Scanlon discloses an expendable cartridge pro-
14 vided with a consumable flash tube containing a booster propellant
15 charge of black powder that is used to ignite the main charge.
16 Scanlon does not disclose a flash tube which functions as an
17 electrical conductor or Faraday shield so as to bleed off inad-
18 vertent electrical charge presented to the flash tube and thus
19 limit the charge transferred to the igniter material.

20 The disclosure of Junker teaches a consumable explosive
21 cartridge having a primer encased in a flexible nitrocellulose
22 capsule. The capsule has a greater volume than the primer so as
23 to facilitate safe handling of the primer during assembly. The
24 larger volume of the capsule ensures that no pressure will be
25 exerted on the primer during the assembly process and thus the
26 cartridge is stable in regard to inadvertent physical shock but is
27 subject to detonation when compressed in an appropriate firing

1 chamber. Again, the device of Junker fails to disclose a flash
2 tube provided with electrical charge dissipating material which
3 functions as a grounded electrical conductor or Faraday shield
4 to bleed off any inadvertent electrical charge presented to the
5 flash tube and thus limit the charge transferred to the igniter.

6 SUMMARY OF THE INVENTION

7 Accordingly, there is provided in the present invention an
8 igniter having a consumable flash tube for encapsulating igniter
9 material embedded in the propellant beds of propelling charges or
10 rocket motors.

11 The flash tube is constructed of a combustible, plastic
12 material such as cellulose nitrate plastic or ethyl cellulose
13 plastic. The combustible, plastic material is furnished with a
14 filler of electrical charge dissipating material, such as acety-
15 lene carbon black, or other electrolytic grade graphite, which
16 renders the flash tube conductive. The conductive flash tube
17 functions as an environmental housing and functions additionally
18 as a grounded electrical conductor or Faraday shield so as to
19 bleed off inadvertent electrical charge presented to the flash
20 tube and thus limit the charge transferred to the igniter material.

21 Formation of the flash tube is accomplished by continuously
22 extruding the mixture of the plastic material and the electrical
23 charge dissipating material to form a hollow tube. After curing
24 of the extruded tube, one end of the tube is flared to provide
25 for joining of the tube to the remaining primer components after
26 the igniter material is positioned in the flash tube. The igniter
27 material may be any ignition material which does not require

1 pressure confinement to function. In addition, the igniter
2 material should not possess hydrophilic properties.

3 OBJECTS OF THE INVENTION

4 It is an object of the present invention to provide an
5 igniter having an inexpensive, consumable flash tube to encapsul-
6 ate igniter material for the propellant beds of propelling charges
7 and rocket motors.

8 Another object of the present invention is to provide a con-
9 sumable flash tube which can be manufactured without expensive
10 and time-consuming machining and inspection.

11 Another object of the present invention is to provide a con-
12 sumable flash tube which functions as an environmental housing for
13 encapsulating igniter material for the propellant beds of propel-
14 ling charges and rocket motors.

15 A further object of the present invention is to provide a
16 consumable flash tube which can be manufactured by continuous
17 extrusion.

18 A still further object of the present invention is to provide
19 a consumable flash tube which functions as a grounded electrical
20 conductor or Faraday shield to bleed off inadvertent electrical
21 charge generated by the propellant bed in which it lies or igniter
22 agent which it houses at a rate which prevents the substantial
23 buildup of charge and thus limits internal charge buildup and the
24 charge transferred to the igniter material.

25 A further object of the present invention is to provide a
26 consumable flash tube which allows for uniform combustion of both
27 the igniter material and propellant bed of a propelling charge or
rocket motor.

1 A still further object of the present invention is to provide
2 an igniter having a consumable flash tube which has a limited
3 impact upon the performance of the propellant bed or the combustion
4 by-products by virtue of the combustion of the flash tube.

5 Other objects, advantages, and novel features of the present
6 invention will become apparent from the following detailed descrip-
7 tion of the invention when considered in conjunction with the
8 drawings.

9 BRIEF DESCRIPTION OF THE DRAWINGS

10 A more complete appreciation of the invention and many of the
11 attendant advantages thereof will be readily understood by refer-
12 ence to the following detailed description when considered with
13 the accompanying drawings in which like reference numerals desig-
14 nate like parts throughout the figures and wherein:

15 Figure 1 illustrates an isometric view in partial cutaway
16 of a projectile cartridge incorporating the flash tube of the
17 present invention; and

18 Figure 2 illustrates in partial cross-section the flash tube
19 of the present invention.

20 DESCRIPTION OF THE PREFERRED EMBODIMENT

21 Referring to Figure 1, there is illustrated an isometric view
22 in partial cutaway of cased ammunition or propelling charge 10
23 incorporating flash tube 14 of the subject invention. Propelling
24 charge 10 is formed with tapered, cylindrical body 11 which en-
25 closes a propellant bed 12. The body is formed with a forward end
26 15 and an after end 17 with forward end 15 being closed by cart-
27 ridge case closure plug 20. Forward end 15 is provided with a

1 tapered portion 16 which encircles and attaches closure plug 20
2 to body 11.

3 Referring to Figure 2, there is illustrated a side view of
4 consumable flash tube 14 in partial cross-section. The flash
5 tube is furnished with a cylindrical, elongated body 18 and pro-
6 vided with an expanded end portion 19. The cylindrical body of
7 tube 14 encloses a cylindrical hollow 21 which extends continu-
8 ously through the tube in which is positioned the igniter material
9 (not shown).

10 The consumable flash tube of the subject invention is con-
11 structed of a combustible, plastic material such as cellulose
12 nitrate plastic, ethyl cellulose plastic or similar material which
13 is consumable upon ignition of the igniter material.

14 The consumable, plastic material is furnished with a filler
15 of electrical charge dissipating material which, when grounded
16 through primer head stock 22, renders flash tube 14 conductive.
17 The conductive flash tube functions as a grounded electrical con-
18 ductor or Faraday shield to bleed off any inadvertent electrical
19 charge above 1,000 volts so as to limit the electrical charge
20 transferred to the igniter material and thus prevent inadvertent
21 initiation of the igniter material. During on-board storage of
22 cartridge case 10, any inadvertent electrical charge created by
23 handling, storage, raising in height, tribo-electric effect, storms
24 or similar occurrences, will be prevented from propagating to the
25 igniter material by the conductive properties of flash tube 14.

26 The combustible material, cellulose nitrate plastic, is a
27 composition of approximately 75% cellulose nitrate and 25% camphor.

1 Dibutylphthalate may be substituted for the camphor in the cellu-
2 lose nitrate plastic.

3 The electrical charge dissipating material which is provided
4 as a filler for the combustible material may be acetylene carbon
5 black, other carbon blacks, other electrolytic grade graphites,
6 or other conductive fillers such as lithium chloride, lead
7 stearate, cupric salicylate or other granular conductive material
8 which is chemically compatible with the plastic material and does
9 not degrade the mechanical properties of the plastic material.
10 Each of the preceding electrical charge dissipating materials can
11 be added to the plastic material in sufficient amounts to render
12 the consumable flash tube conductive, without degrading the plastic
13 characteristic of the consumable plastic material, so as to create
14 a Faraday shield for the igniter material encapsulated in flash
15 tube 14. By way of example, granular acetylene carbon black added
16 to the plastic material in a ratio of approximately 10% by weight
17 of carbon black to approximately 90% plastic material will render
18 the flash tube sufficiently conductive. A granular type filler is
19 preferred because of the high surface area to volume ratio, al-
20 though it is to be understood that other types of filler, besides
21 granular, may be used.

22 The buildup of electrostatic charge in a material is a highly
23 transient phenomena - limited only by the resistivity of an in-
24 volved region or by dielectric breakdown for larger voltage and
25 charge levels. The resistivity of a material will determine the
26 rate at which bleed off of electrostatic charge will occur. If
27 the bleed off is at least of the order of the charge buildup rate

1 for a given mode of charge generation, little charge will be
2 allowed to accumulate. For most charge generation modes a resist-
3 ivity of $10\text{ M}\Omega \rightarrow 100\text{ M}\Omega$ is generally considered sufficient for
4 the prevention of appreciable charge, i.e., that charge considered
5 to be hazardous in the handling of explosives. Flash tube 14,
6 incorporating the electrical charge dissipating material, provides
7 an adequately conductive container for protection of the igniter
8 material from any externally generated charge.

9 Formation of flash tube 14 is accomplished by continuously
10 extruding the mixture of the plastic material and the electrical
11 charge dissipating material to form a hollow, cylindrical tube.
12 Alternatively, flash tube 14 can be formed by rolling the mixture
13 on a mandrel to obtain a seamed tube. The seam of the tube is
14 then closed with a suitable adhesive. After curing of the mixture,
15 one end of the tube is flared, illustrated at 19 in Figure 2, to
16 provide for joining of the tube to the primer head stock, illus-
17 trated at 22 in Figure 1. The igniter material is positioned in
18 cylindrical hollow 21, of Figure 2, and may be any ignition
19 material that does not require pressure confinement to function
20 properly or have hydrophilic properties.

21 It is thus apparent that the disclosed consumable flash tube
22 for encapsulating igniter material in the propellant beds of
23 propelling charges or rocket motors provides a flash tube which
24 can be manufactured by continuous extrusion, without expensive
25 and time-consuming machining and inspection. The consumable
26 flash tube provides for uniform combustion of both the encapsulated
27 igniter material and propellant bed of the propelling charges, with

1 minimal effect on the combustion process or combustion by-products,
2 and functions as a grounded electrical conductor or Faraday shield
3 to bleed off any inadvertent electrical charge presented to the
4 flash tube and thus limit the electrical charge transferred to the
5 igniter material.

6 Many obvious modifications of the specific invention, other
7 than those set forth above, will readily come to mind to one
8 skilled in the art having the benefit of the teachings presented
9 in the foregoing description and the accompanying drawings of the
10 subject invention and hence it is to be understood that such
11 modifications are included within the scope of the appended claims.